

CLAIMS

1. In a PEM fuel cell having at least one cell comprising (a) a pair of opposite polarity electrodes each having a first face exposed to a fuel cell reactant and a second face engaging a membrane-electrolyte interjacent said electrodes, (b) a porous, electrically-conductive media engaging said first face for distributing said reactant over, and conducting electrical current from, said first face, and (3) a current collector engaging said media for conducting electrical current from said medium, said current collector comprising a composite having a first conductivity and comprising corrosion-proof, electrically conductive filler dispersed throughout an oxidation-resistant and acid-resistant, water-insoluble polymeric matrix, the improvement comprising an oxidation-resistant and acid-resistant hyperconductive surface layer on said current collector and engaging said media, said hyperconductive surface layer having a second conductivity greater than said first conductivity for shunting electrical current passing through said media into said surface layer to such of said filler as resides at the interface between said surface layer and said composite, and thereby reduce the contact resistance that would otherwise exist between said composite and said media absent said surface layer.

2. A fuel cell according to claim 1 wherein said filler is selected from the group consisting of gold, platinum, graphite, conductive carbon, palladium, rhodium, ruthenium, and the rare earth metals.

3. A fuel cell according to claim 1 wherein said filler comprises a plurality of particles.

4. A fuel cell according to claim 1 wherein said current collector is comprised entirely of said composite.

5. A fuel cell according to claim 1 wherein said current collector comprises a metal substrate having a coating of said composite thereon.

6. A fuel cell according to claim 3 wherein said particles are fibrillose and oriented in the general direction that the electrical current flows through the composite.

7. A fuel cell according to claim 1 wherein said filler comprises continuous fibers that extend through the thickness of said composite.

8. A fuel cell according to claim 1 wherein at least one of said current collectors is a bipolar plate confronting the anode of one said cells and the cathode of the next adjacent cell.

9. A fuel cell according to claim 5 wherein said substrate comprises a first acid-soluble metal underlying a second acid-insoluble, oxidizeable metal layer engaging said composite.

10. A fuel cell according to claim 5 wherein said metal is selected from the group consisting of titanium, stainless steel, and aluminum.

11. A fuel cell according to claim 1 wherein said polymer matrix is selected from the group consisting of epoxies, polyamide-imides, polyether-imides, polyphenols, fluoro-elastomers, polyesters, phenoxy-phenolics, epoxide-phenolics, acrylics, and urethanes.

12. In a PEM fuel cell having at least one cell comprising (a) a pair of opposite polarity electrodes each having a first face exposed to a fuel cell reactant and a second face engaging a membrane-electrolyte interjacent said electrodes, (b) a porous, electrically-conductive media engaging said first

face for distributing said reactant over, and conducting electrical current from, said first face, and (3) a current collector engaging said media for conducting electrical current from said medium, said current collector comprising a composite having a first conductivity and comprising corrosion-proof electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant, water-insoluble polymeric matrix, the improvement comprising a hyperconductive surface layer on said current collector and engaging said media, said hyperconductive surface layer having a second conductivity greater than said first conductivity and comprising a plurality of oxidation-resistant and acid-resistant, electrically-conductive particles adhering to a surface of said composite confronting said media.

13. A PEM fuel cell according to claim 12 wherein said particles comprise graphite.

14. A PEM fuel cell according to claim 12 wherein said particles are at least partially embedded in said surface.

15. In a PEM fuel cell having at least one cell comprising (a) a pair of opposite polarity electrodes each having a first face exposed to a fuel cell reactant and a second face engaging a membrane-electrolyte interjacent said electrodes, (b) a porous, electrically-conductive media engaging said first face for distributing said reactant over, and conducting electrical current from, said first face, and (3) a current collector engaging said media for conducting electrical current from said medium, said current collector comprising a composite having a first conductivity and comprising corrosion-proof, electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant, water-insoluble polymeric matrix, the improvement comprising a hyperconductive surface layer covering said current collector and engaging said media, said layer having a second conductivity greater than said first

conductivity and comprising a continuous, oxidation-resistant, and acid-resistant film on the surface of said composite confronting said media.

16. A PEM fuel cell according to claim 15 wherein said film comprises a vapor-deposited conductor.

17. A PEM fuel cell according to claim 15 wherein said film comprises an electrolessly-deposited metal.

18. A PEM fuel cell according to claim 15, wherein said film comprises a plurality of corrosion-proof conductive particles dispersed throughout an oxidation-resistant and acid-resistant polymer matrix.

19. A method of making a current collector for a fuel cell comprising the steps of forming said current collector at least in part from a composite material having a first conductivity and comprising corrosion-proof, electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant, polymeric matrix, and adhering a sufficient quantity of electrically conductive particles to a surface of said composite material to provide said surface with a conductivity greater than said first conductivity.

20. A method according to claim 19 including the step of molding said current collector from said composite material.

21. A method according to claim 19 including the step of forming said current collector from a metal substrate having a coating of said composite material thereon.

22. A method of making a current collector for a fuel cell comprising the steps of coating an electrically conductive substrate with a tacky layer of uncured or undried material comprising a corrosion-proof,

electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant polymer, embedding a plurality of electrically-conductive particles in a surface of said layer so as to increase the conductivity of said surface over the conductivity of the remainder of said material, and curing or drying said layer.

23. A method according to claim 22 comprising spraying said particles onto said surface.

24. A method according to claim 22 wherein said electrically conductive substrate is molded from a composite material comprising corrosion-proof, electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant, water-insoluble polymer.

25. A method according to claim 22 wherein said substrate comprises a metal.

26. A method of making a current collector for a fuel cell comprising the steps of molding said current collector from a composite material having a first conductivity and comprising corrosion-proof, electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant polymeric matrix and embedding a sufficient quantity of corrosion-proof electrically-conductive particles in a surface of said composite to provide said surface with a conductivity greater than said first conductivity.

27. A method according to claim 26 including the step of softening said surface before embedding said particles in said surface.

28. A method according to claim 26 including the step of heating said polymeric matrix material to soften said surface.

29. A method according to claim 26 including the step of wetting said surface with a solvent for said polymeric matrix material to soften said surface.

30. A method of making a current collector for a fuel cell comprising the steps of (1) forming said current collector at least in part from a composite material having a first conductivity and comprising corrosion-proof, electrically-conductive filler dispersed throughout an oxidation-resistant and acid-resistant polymer matrix, and (2) abrading a surface of said current collector sufficiently to remove said matrix polymer from said filler at said surface and to smear said filler over said surface so as to increase the conductivity of said surface to a conductivity greater than said first conductivity.